Introduction to Cloud Computing and Costing

2021 Joint IT and Software Cost Forum
September 15, 2021

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Agenda

Introduction to Cloud Computing

- What is cloud computing and how is it useful?
- Discuss history of cloud computing
- Types of cloud computing and services
- What is new in the cloud?

Cloud Computing Issues

- Discuss issues in cloud computing
- Challenges of migrating to the cloud
- GAO reported cloud challenges

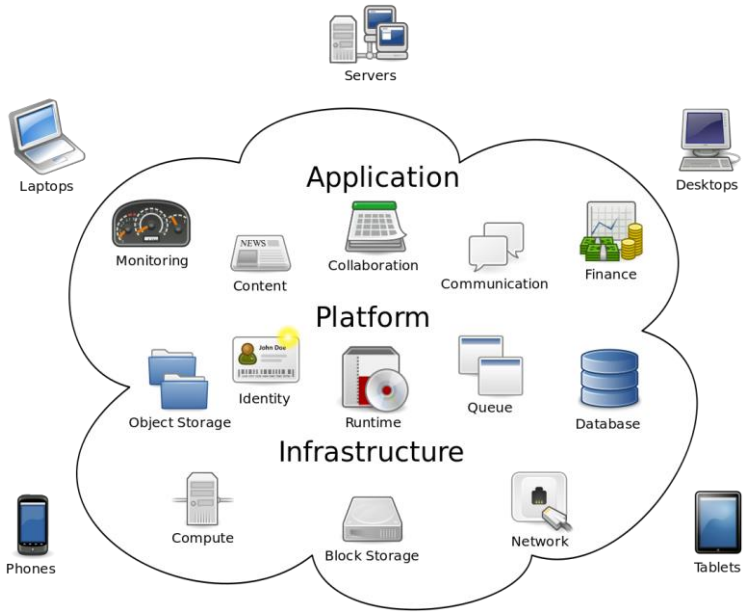
Cloud Cost Models

- Discuss different cloud providers and provider pricing calculators
- Cloud computing cost models including Cost Estimating Relationships (CERs), common cost drivers, and total ownership cost
- DoD cloud management approach

Cloud Computing Definition - Informal

What is the “Cloud”?

- The “cloud" started off as a tech industry slang term
- The definition for the cloud can seem foggy, but essentially, it’s a term used to describe a global network of servers, each with a unique function
- In the simplest language, Cloud Computing is simply a sophisticated outsourcing of if IT services
- First diagrams typically showed technical diagrams representing servers and networking infrastructure that make up the Internet as a cloud
- Today, "the cloud" is a widely accepted term within the IT community



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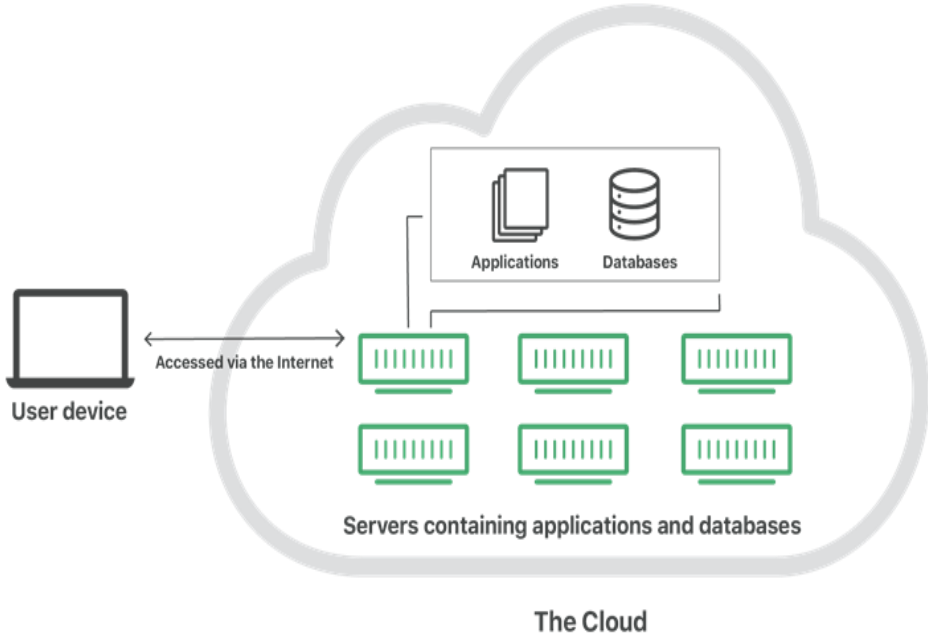
Cloud Computing Definition- Formal

What is the "Cloud"?

- Internet-based computing where large groups of remote servers are networked
- Allows sharing of data-processing tasks, centralized data storage, and online access to computer services or resources
- Any computer related task that is done entirely on the Internet
- Allows users to deal with the software without having the hardware
- Everything is done remotely
- Little or nothing is saved locally
- Physical assets are also required



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Cloud Computing Definition – Dummies

What is the "Cloud"?

- Cloud computing is a method to provide shared computing resources, including applications, computing, storage, networking, development, and deployment platforms as well as business processes
- Today, most businesses use cloud-based services — even if they don't think of it as a cloud (e.g., Microsoft 365, Slack, or DocuSign)
- Consumers utilize computing resources only when they want to and are only charged for the resources they use, for the time they use those resources.

Source: Hurwitz, Judith S.; Kirsch, Daniel. *Cloud Computing For Dummies*, 2009

Cloud Computing History

1950s	1960s	1990s	2000	Beyond 2010
Mainframes	**Rise of the PC**	**Client/Server Architecture**	**Hosted Environment**	**Cloud Computing**
Start of Automation phase	Rise of demand of personal desktops	Virtual private network offered	IT infrastructure management outsourcing	Emergence of "as a service"
Localized Infrastructure	Decentralized computing	Demand for high bandwidth	Increase use of virtualization	Delivery of IaaS, PaaS, SaaS, NaaS
	Birth of IT Services Industries	Dot Com revolution		Collaborative computing
				Utility computing model




NIST Cloud Definition

Four Deployment Models

Hybrid Clouds

Private Clouds

Community Clouds

Public Clouds

Three Service Models

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

Five Essential Characteristics

- On Demand Self Service
- Broad Network Access
- Resource Pooling
- Measured Service
- Rapid Elasticity

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Cloud Computing - Types and Services

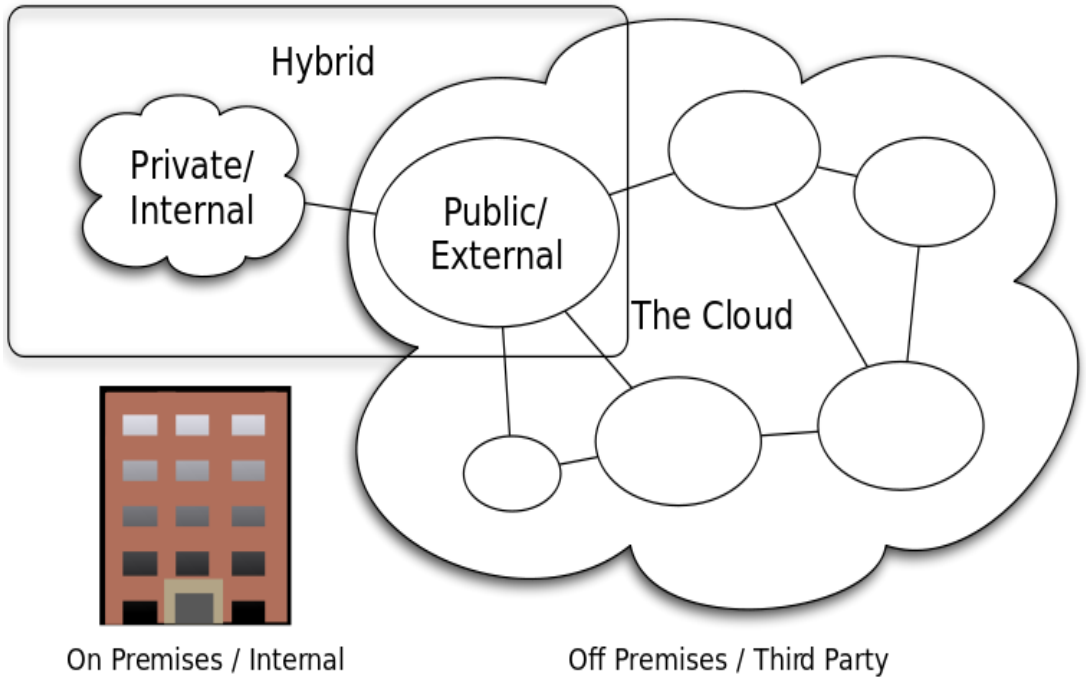
Public Cloud
- Done by service providers

Community Cloud
- Organizations from a specific community with common concerns

Private Cloud
- Operated solely for a single organization

Hybrid Cloud
- Composition of two or more clouds (private, community or public)
- Virtual Private Cloud Public cloud provider creates private environment

Other Cloud Types
- Distributed Cloud
- Multi Cloud
- Poly Cloud
- Big Data Cloud
- High Performance Cloud (HPC)



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Cloud Computing – What's New?

Cloud Service Models Will Continue to Evolve

BPaaS Business Process as a Service	FaaS Functions as a Service	iDaaS Identity as a Service
FWaaS Firewall as a Service	iPaaS integration Platform as a Service	MBaaS Mobile Backend as a Service
SECaaS Security as a Service	Cloud delivered Security as a Service (SECaaS)	XaaS Anything as a Service

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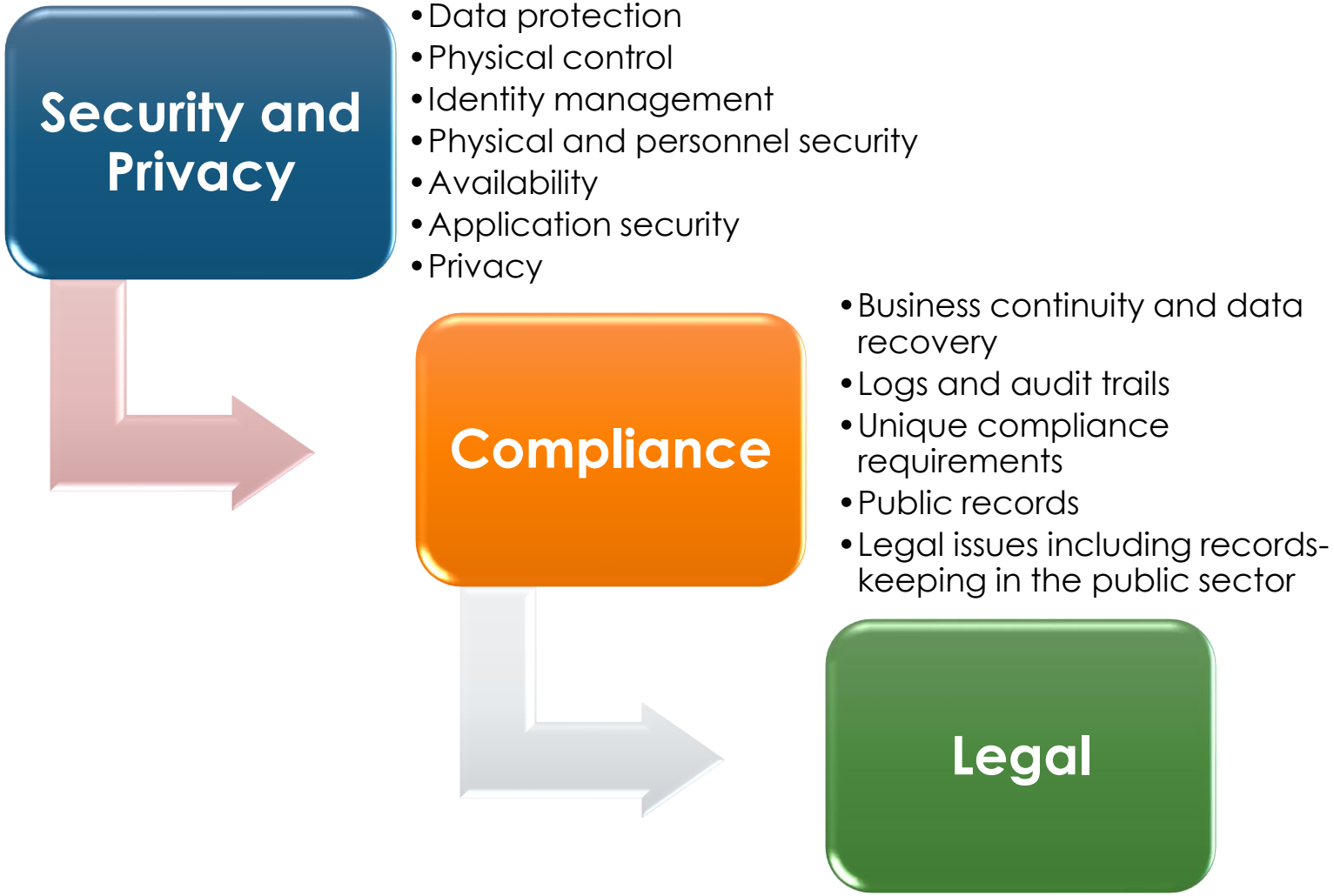
Cloud Computing Issues



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Challenges to Migrating to the Cloud

- Connecting Old Data with New Cloud Applications
- Time and Cost of Migration
- Program Termination
- Building a cloud from scratch
- Cloud vs. On-premise mindset
- Security and Compliance Adjustments
- Choosing the Proper Storage Options
- Getting Staff Prepared for the Migration

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GAO Reported Cloud Challenges

1. Meeting Federal Security Requirements
2. Obtaining guidance
3. Acquiring knowledge and expertise
4. Certifying and accrediting vendors
5. Ensuring data portability and interoperability
6. Overcoming cultural barriers and
7. Procuring services on a consumption (on-demand) basis

"As a result of these identified issues, it is likely that agency-reported cloud spending and savings figures were underreported"

"Agencies Need to Develop Modernization Plans for Critical Legacy Systems."

GAO Reported Cloud Challenges

Table 1: The 10 Most Critical Federal Legacy Systems in Need of Modernization

Agency	System name[a]	System description[a]	Age of system, in years	Age of oldest hardware, in years	System criticality (according to agency)	Security risk (according to agency)
Department of Defense	System 1	A maintenance system that supports wartime readiness, among other things	14	3	Moderately high	Moderate
Department of Education	System 2	A system that contains student information	46	3	High	High
Department of Health and Human Services	System 3	An information system that supports clinical and patient administrative activities	50	Unknown[b]	High	High
Department of Homeland Security	System 4	A network that consists of routers, switches, and other network appliances	Between 8 and 11[c]	11	High	High
Department of the Interior	System 5	A system that supports the operation of certain dams and power plants	18	18	High	Moderately high
Department of the Treasury	System 6	A system that contains taxpayer information	51	4	High	Moderately low
Department of Transportation	System 7	A system that contains information on aircraft	35	7	High	Moderately high
Office of Personnel Management	System 8	Hardware, software, and service components that support information technology applications and services	34	14	High	Moderately low
Small Business Administration	System 9	A system that controls access to applications	17	10	High	Moderately high
Social Security Administration	System 10	A group of systems that contain information on Social Security beneficiaries	45	5	High	Moderate

Familiar Cloud Service Providers

Google Cloud

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Gartner Magic Quadrant for Cloud Infrastructure and Platform Services 2020

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Cloud Service Models

Typical Findings for Cloud Offerings

Pros

- Best at **small scale** with a simple cost structure and few teams
- Integration into PowerBI and AWS (through Cloud) allows for **better reporting and dashboards**
- Provides recommendations for how **you can save** based on your usage
- Allows to set **budgeting alerts**
- **No additional cost** for customers

Cons

- Requires **good tag hygiene** for granular cost visibility
- **Can't see idle or unallocated** resource costs
- Difficult to **see costs outside** of provider, including multi-cloud and cluster costs
- **Difficult to rely on exclusively** as the organization scales, even for high-level finance and with PowerBI integration
- **Not built to be proactive,** only to see cost reports after the fact (with the ability to set warnings)

Common Cloud Cost Drivers

Dependent Variable	Predictor Variables (Cost Drivers)
Migration Costs	• Storage Size • Number of Physical Servers • Number of Virtual Machines
Annual Costs	• Storage Size • Number of Physical Servers • Number of Virtual Machines • Number of Workloads under CloudOps • Complexity of Workloads • Security Requirements • Monitoring Requirements • CloudOps Multiplier • GB RAM • GB Storage
IaaS Costs	• CPUs • Memory

Cloud migration costs and its drivers is an area of continued research

Sample Cloud Cost Estimating Relationships (CERs)

CER (Annual Cost)	Source
A + B(**Physical Servers**)	DHS Cloud Analysis, 2018
(Number of Workloads*Workload Complexity)*__Cloud Ops__ Multiplier)+((Number of Workloads*Workload Complexity)*Security Requirements)+((Number of Workloads*Workload Complexity)*Monitoring Requirements	David S. Linthicum, InfoWorld, March 2017
A + B(**GB RAM**)	PRICE/MITRE
A (**CPUs**) + B (**Local Disk Storage**) + C(**Memory**) - D	PRICE/MITRE, 2020

Examples of sound Cloud Computing CERs and their cost drivers

Sample Cloud Cost Estimation Relationship (CER) using CloudOps

CloudOps is the ability to operate in a cloud environment once the applications and data arrives. How much will this cost?

- NW: Number of workloads under cloudops
- CW: Complexity of workloads (on a scale of 1.01 to 2.0)
- SR: Security requirements (on a scale of 100 to 500)
- MR: Monitoring requirements (on a scale of 100 to 500)
- COM: Cloudops multiplier (on a scale of 1,000 to 10,000), based on resources used, including the cost of cloud services and the cost of people

The typical calculation looks like this:

```
Cloudops Cost Per Year = ((NW*CW)*COM)+((NW*CW)*SR)+
((NW*CW)*MR)
```

Thus, a typical use case would be:

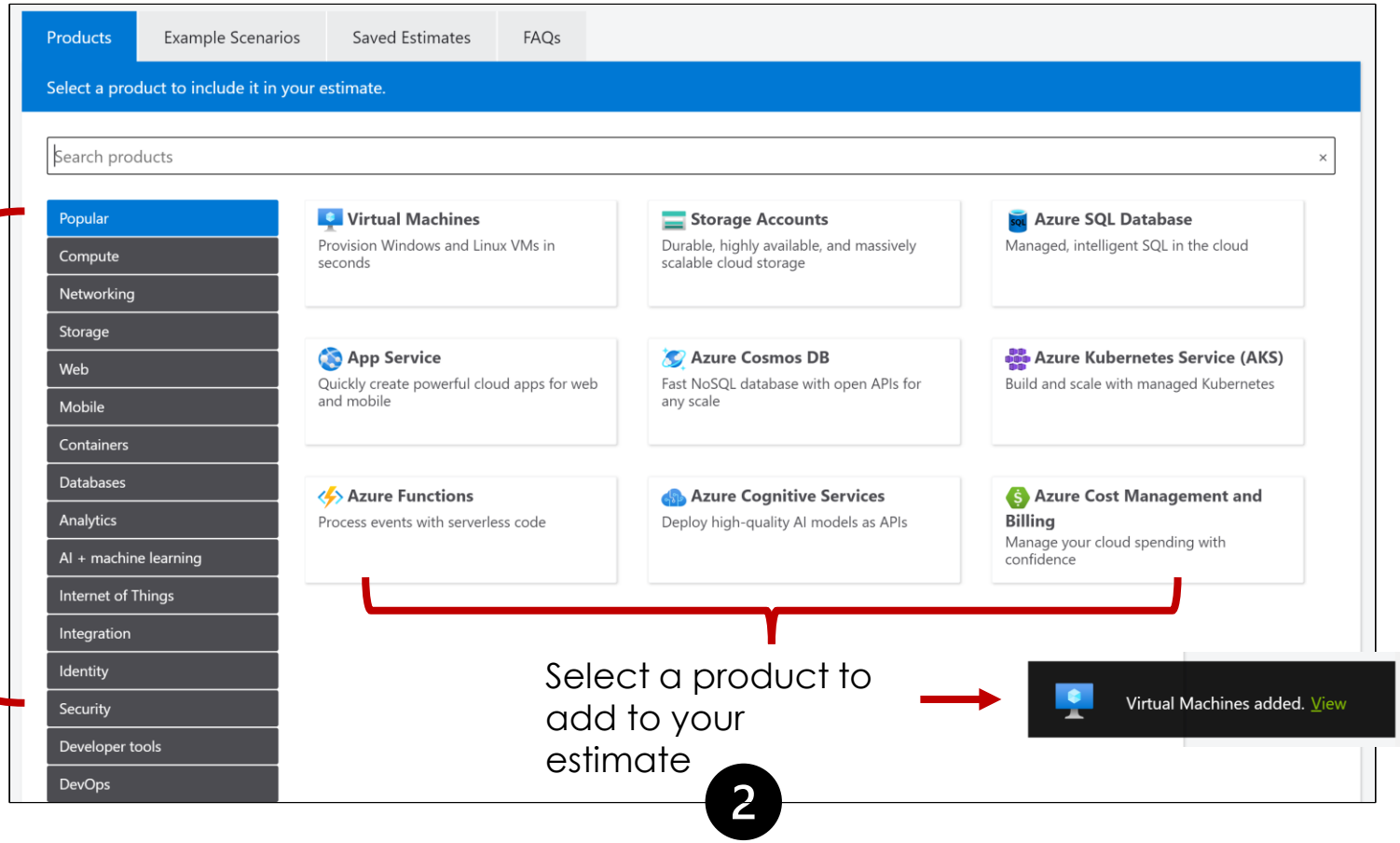
```
Cloudops Cost Per Year = ((1,000*1.75)*5,000)+
((1,000*1.75)*350)+((1,000*1.75)*250)
```

This example comes to $9.8 million per year = $8,750,000 + $612,500 + $437,500. Thousand fairly complex workloads (CW=1.75), with above-average security complexity (SR=350), average monitoring complexity (MR=250), and low resource usage (COM=1,000).

Source: https://www.infoworld.com/article/3182492/calculate-your-cloud-costs-with-this-simple-formula.html

Most Cloud Services Provide Pricing Calculators - Example

Pricing Calculator | Microsoft Azure



1

Categories for Cloud Products

Select a product to add to your estimate

2

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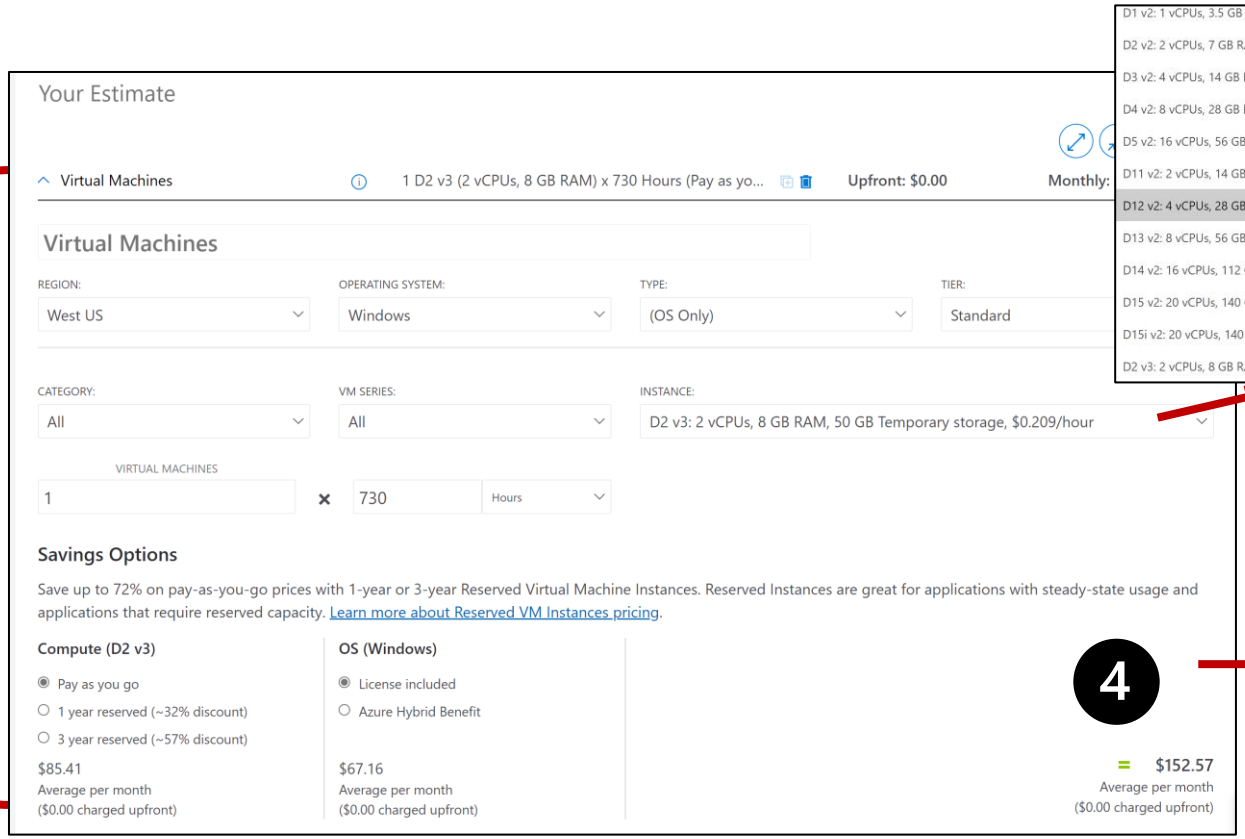
Azure Pricing Calculator - Example

[Pricing Calculator | Microsoft Azure]

3

Customize your Product



4

Estimate for your Cloud product ready to be plugged into SEER

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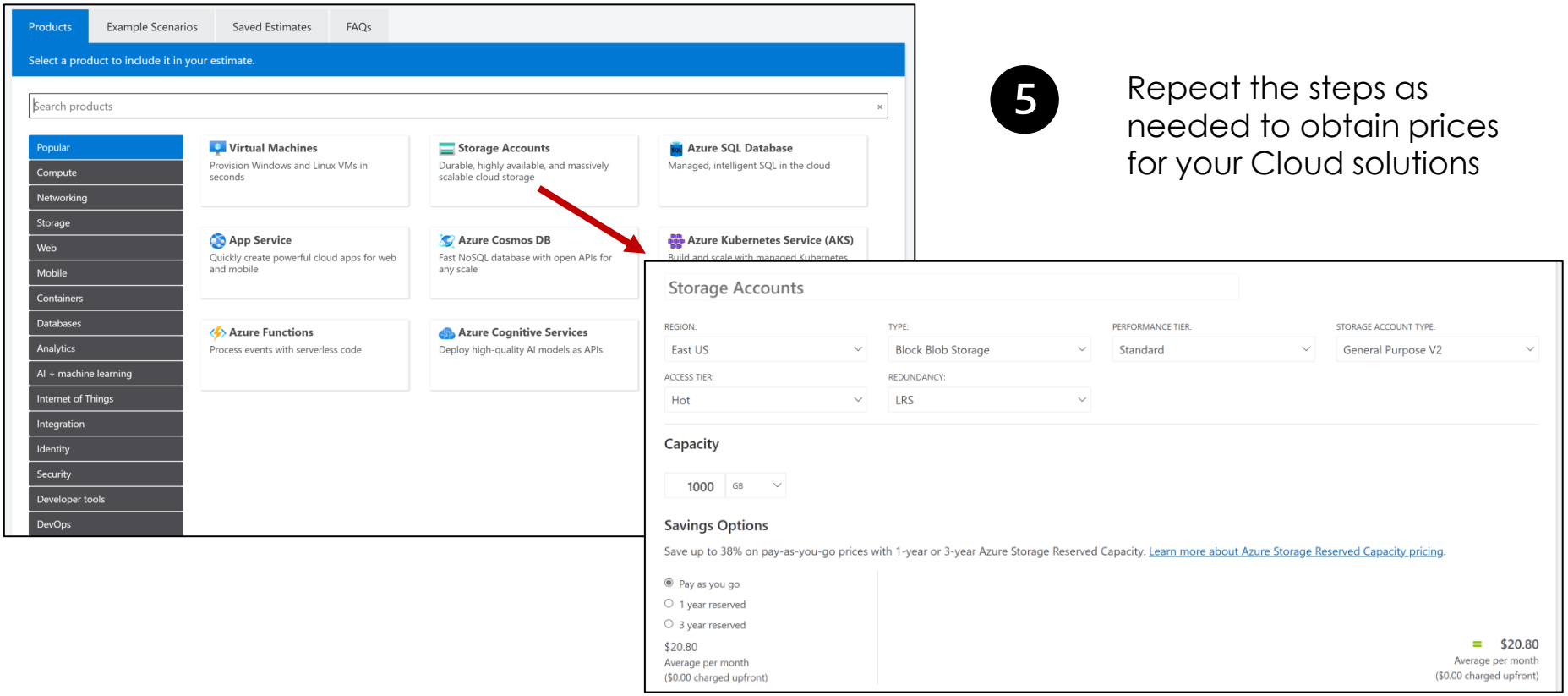
Azure Pricing Calculator - Example

[Pricing Calculator | Microsoft Azure]



5 Repeat the steps as needed to obtain prices for your Cloud solutions

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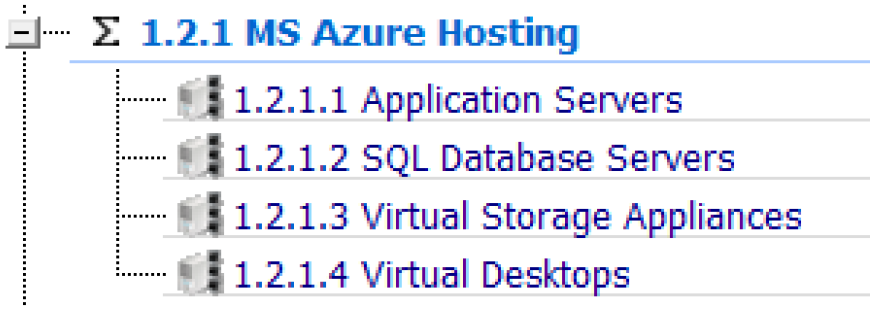
Azure Pricing Calculator - Example

Pricing Calculator | Microsoft Azure



6

Create Purchased HW/SW elements to include cloud hosted services

Are we done ?

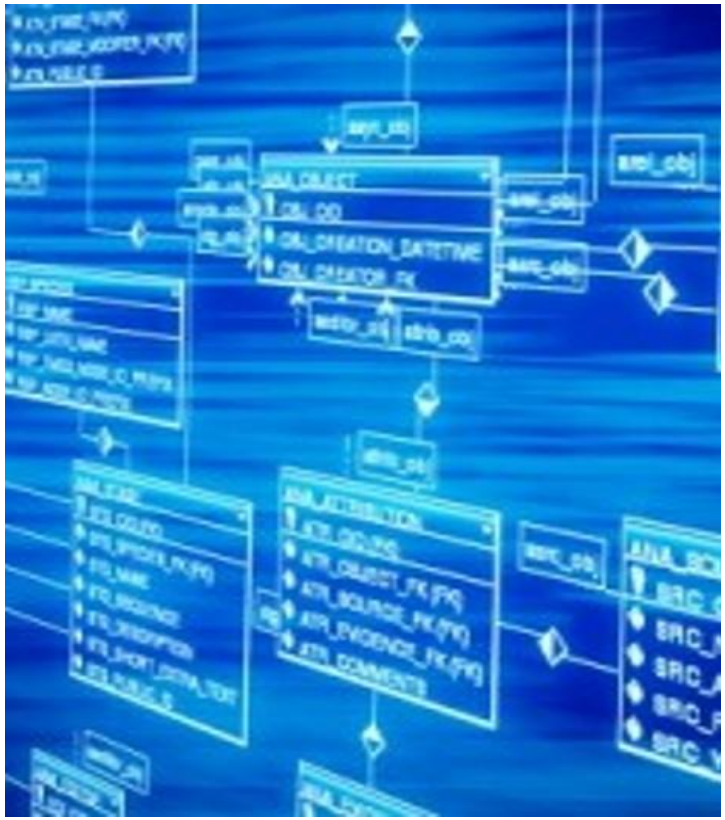
No. We are missing the **Labor!**

The Azure Pricing Calculator (and any other online calculators) will provide a quote for the **product only** (i.e., VM, Storage, Service, Hub, etc.) **You still need to estimate the labor to setup and configure the solution**.

Cloud Computing Cost

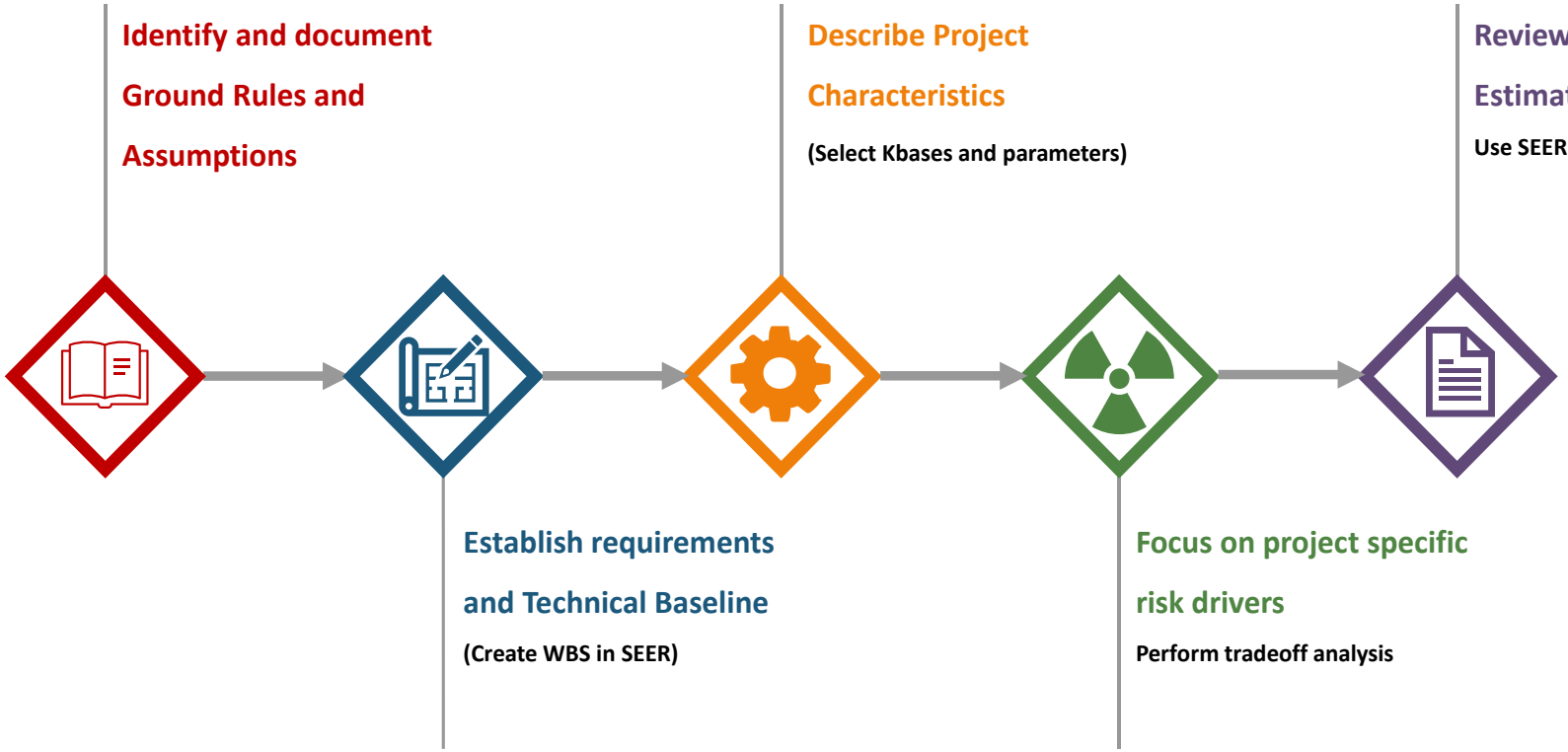
Not Everything is in the Cloud!

- Deciding to move to the cloud is a decision about outsourcing
- A cloud service is an application or device which is accessed thru the internet
- Each type of cloud service varies between how much of the service is organizationally managed and how much is managed by the cloud provider service
- Cost estimates should capture costs that are not in the cloud service offering to understand **Total Cost of Ownership**



Estimating Cloud Cost Needs a Process

Understanding the Cost of Cloud Decisions requires a **Process**



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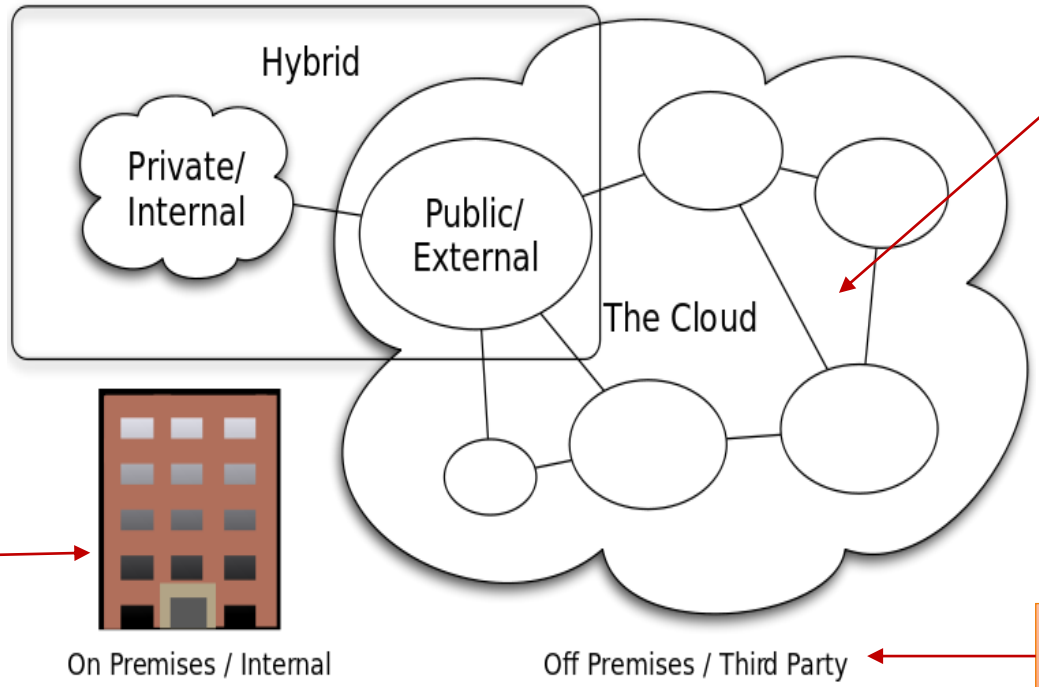
What Are You Estimating?

Establishing Ground Rules and Assumptions



1. What is in the cloud?

2. What is on premise?

3. What else is needed?

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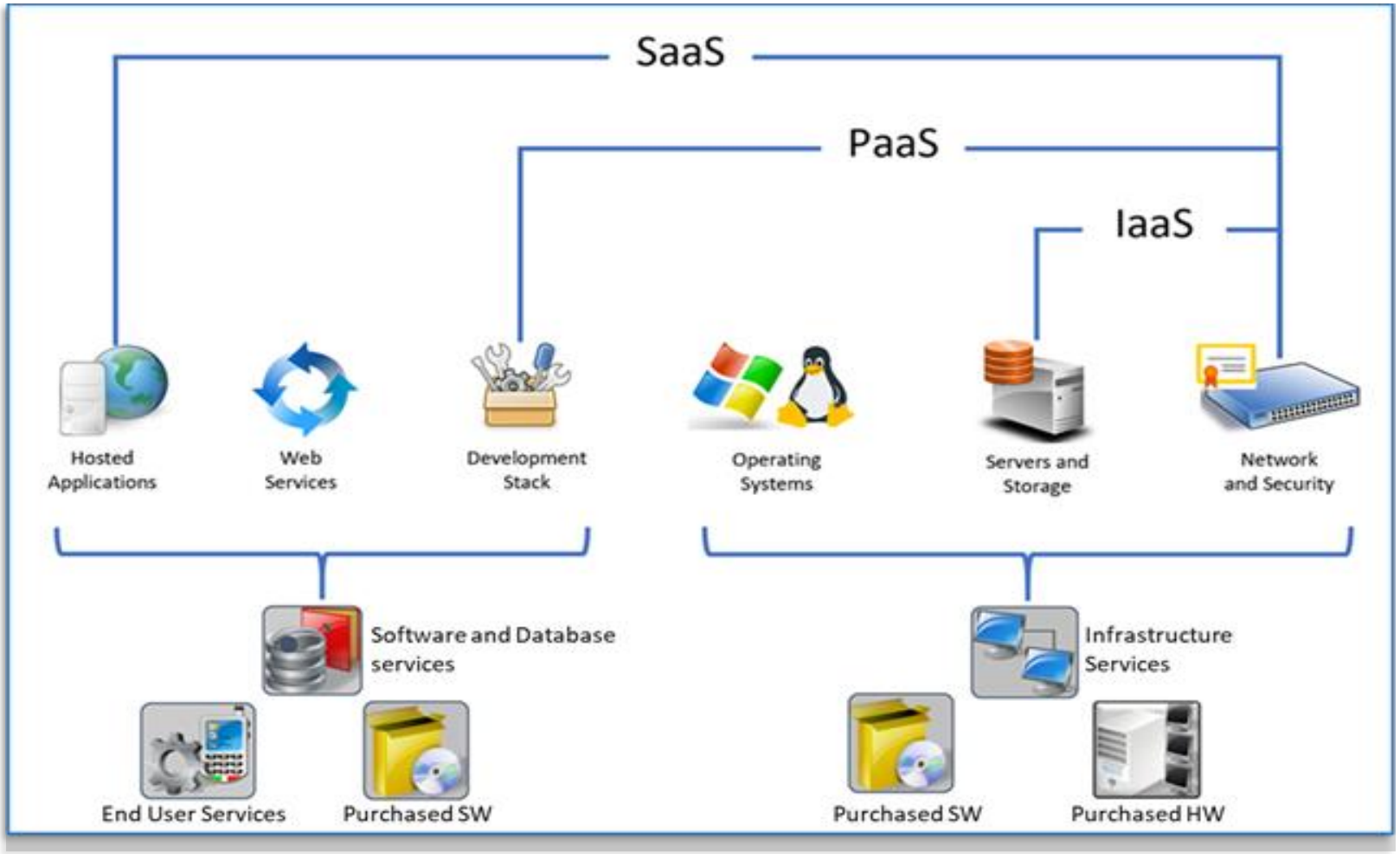
What Do You Need from the Cloud?



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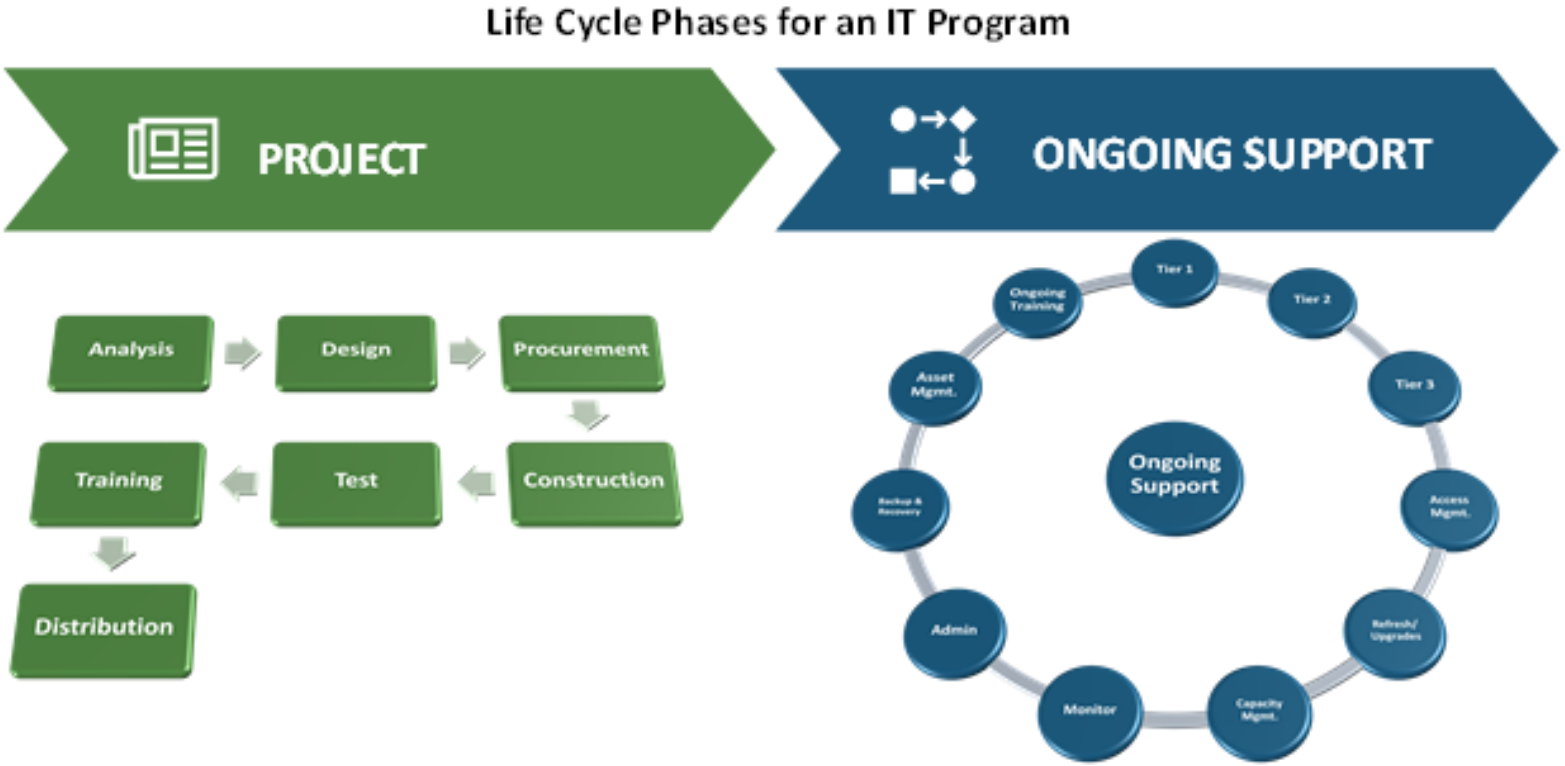
Understanding Total Ownership Cost

The analyst needs to consider more than what the service providers provide



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Cloud Computing Cost

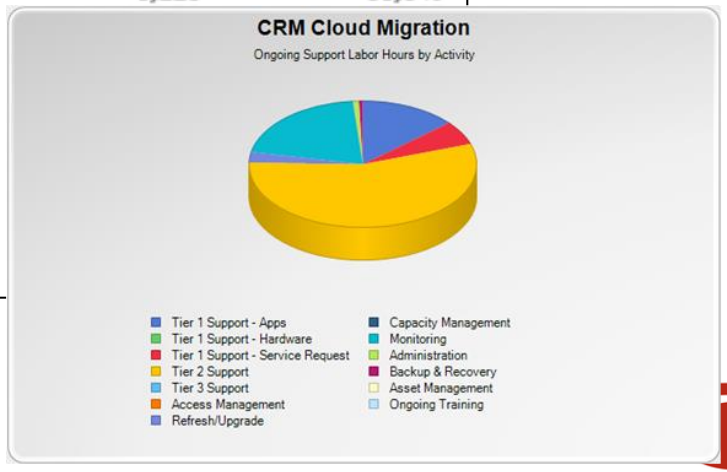
Most Ownership Costs are Potentially Not in the Cloud

Ongoing Support Activity Detail

ACTIVITY	HOURS	LABOR COST	MATERIAL COST	TOTAL COST
Tier 1 Support - Apps	445,146.45	2,448,305.48	0.00	2,448,305.48
Tier 1 Support - Hardware	67,919.19	373,555.54	0.00	373,555.54
Tier 1 Support - Service Request	227,283.44	1,250,058.94	0.00	1,250,058.94
Tier 2 Support	1,552,812.41	9,682,212.54	520,000.00	10,202,212.54
Tier 3 Support	1,000.00	5,500.00	0.00	5,500.00
Access Management	87,109.05	479,099.77	0.00	479,099.77
Refresh/Upgrade	1,074,428.95	8,422,224.33	923,240.00	9,345,464.33
Capacity Management	91,378.09	913,780.90	0.00	913,780.90
Monitoring	312,867.87	1,720,773.31	0.00	1,720,773.31
Administration	358,901.68	1,993,561.21	0.00	1,993,561.21
Backup & Recovery	91,507.42	516,210.30	0.00	516,210.30
Asset Management	196,356.57	1,793,016.97	0.00	1,793,016.97
Ongoing Training	27,786.00	152,823.00	0.00	152,823.00
Total Ongoing Support	4,534,497.13	29,751,122.30	1,443,240.00	31,194,362.30

ONGOING SUPPORT METRICS	Tier 1 Incidents	Tier 1 Service Requests	Tier 2 Incidents	Total
Total Volume (all years)	193,357	82,867	82,263	358,488
Average/Year	19,336	8,287	8,226	35,849
Average Cost Per Ticket	14.59	15.09		
Tickets Resolved At Level 1	154,686	0		
Tickets Per Technician Per Month	57	55		
Average Ticket Work Time (minutes)	159.21	164.56		

	Average/Year	Total
End Users Added/Replaced	1,316	13,162
Infrastructure Added/Replaced	2,396	23,962
Users Added/Turnover	193	1,934
Software Updates	4	39



DoD Cloud Management Approach

Three-Tiered Approach to Cloud Computing

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How Is It Going – milCloud 2.0?

- CSRA (now GD) won the $500 million milCloud 2.0 contract in June 2017
- Launched three months **ahead of schedule** in February 2018
- In May 2018, the DoD mandated that agencies move more than 100 data centers to milCloud 2.0 by the end of FY20
- This included 32,000 separate servers, many of which did not meet the latest security requirements
- Just one in five mission partners were moving to milCloud 2.0, and sources tell us that **migration progress has continued to be slow**
- **Good News** - addition of Amazon Web Services (AWS) to the milCloud 2.0 contract, milCloud 2.0 is poised to **provide both fit-for-purpose and general-purpose clouds to meet a wide variety of DoD requirements**

source: https://www.meritalk.com/articles/department-of-defense-cloud-delays-stall-ai-cyber-progress/

How Is It Going – DEOS?

- The contract was ultimately awarded to **GDIT** in late October 2020
- **DISA will take the lead** in migrating its users to the cloud-based environment, which will deliver Microsoft Office 365-based collaboration and email services
- **Broader deployment across the DoD** will roll out this summer 2021
- **Good News:** President of GDIT, said the company "stands ready to execute this critical work, which will provide enterprise-wide visibility and collaboration capabilities across the Department of Defense."

source: https://www.meritalk.com/articles/department-of-defense-cloud-delays-stall-ai-cyber-progress/

How Is It Going – JEDI?

- On July 6, 2021, the Department of Defense (DOD) announced that it was **terminating the $10 billion Joint Enterprise Defense Infrastructure (JEDI) cloud project**
- Program would have provided **enterprise-wide commercial cloud capabilities** for DOD's classified and unclassified networks
- Originally awarded to Microsoft in 2019, the **JEDI program has been plagued by legal challenges**
- In **resetting its approach** to enterprise cloud capability, DOD announced a **new cloud initiative: the Joint Warfighter Cloud Capability (JWCC)**
- **Good News:** The Pentagon announced a **multi-cloud, multi-vendor contract** instead of a single vendor
- **AWS and Microsoft are currently the only two cloud service providers**, but other providers (e.g., Oracle, Google, and IBM) will be evaluated for potential eligibility later

source: https://www.csis.org/analysis/pentagon-issues-order-66-terminate-jedi

Common Questions about Cloud Service Costs

- ✓ Is everything in the cloud?
- ✓ Are there calculators available?
- ✓ Are there reliable Cost Estimation Relationships (CERs)?
- ✓ Are there DoD Rules to follow?
- ✓ How does one price cloud solutions?
- ✓ and the **big question**…

Is the Cloud Cheaper?

Surveys Would Challenge the Claim!

*Survey of **100 IT decision-makers** in companies with 500 or more employees conducted by NetEnrich found that **85 percent claimed either moderate or extensive production use of cloud infrastructure**.*

"… the **top cloud computing issue is security** (68 percent), followed by IT spend and **cost overruns** (59 percent), **day-to-day maintenance** (36 percent), and **root-cause analysis** and **post-mortems** (22 percent).

Also, 48 percent claim that their IT organization is finding the **cost of recruiting cloud professionals to solve the cloud problems to be an ongoing issue**."

The **"cloud isn't so cheap after all"** conclusion is the dirty little secret of Silicon Valley right now, backed by a decade's worth of data…

The **core issue is that the expectations are the wrong ones**. While cloud providers and even cloud experts have been selling cloud computing as an operational cost-savings technology, the reality is that **the cloud can be more expensive due to cost of the talent needed, of migration, and of cloud operations (cloudops).**

Source: David Linthicum https://www.infoworld.com/article/3336046/why-cloud-computing-suddenly-seems-so-hard-and-expensive.html

Cloud Computing Cost Models

What are we getting and what are we forgetting?

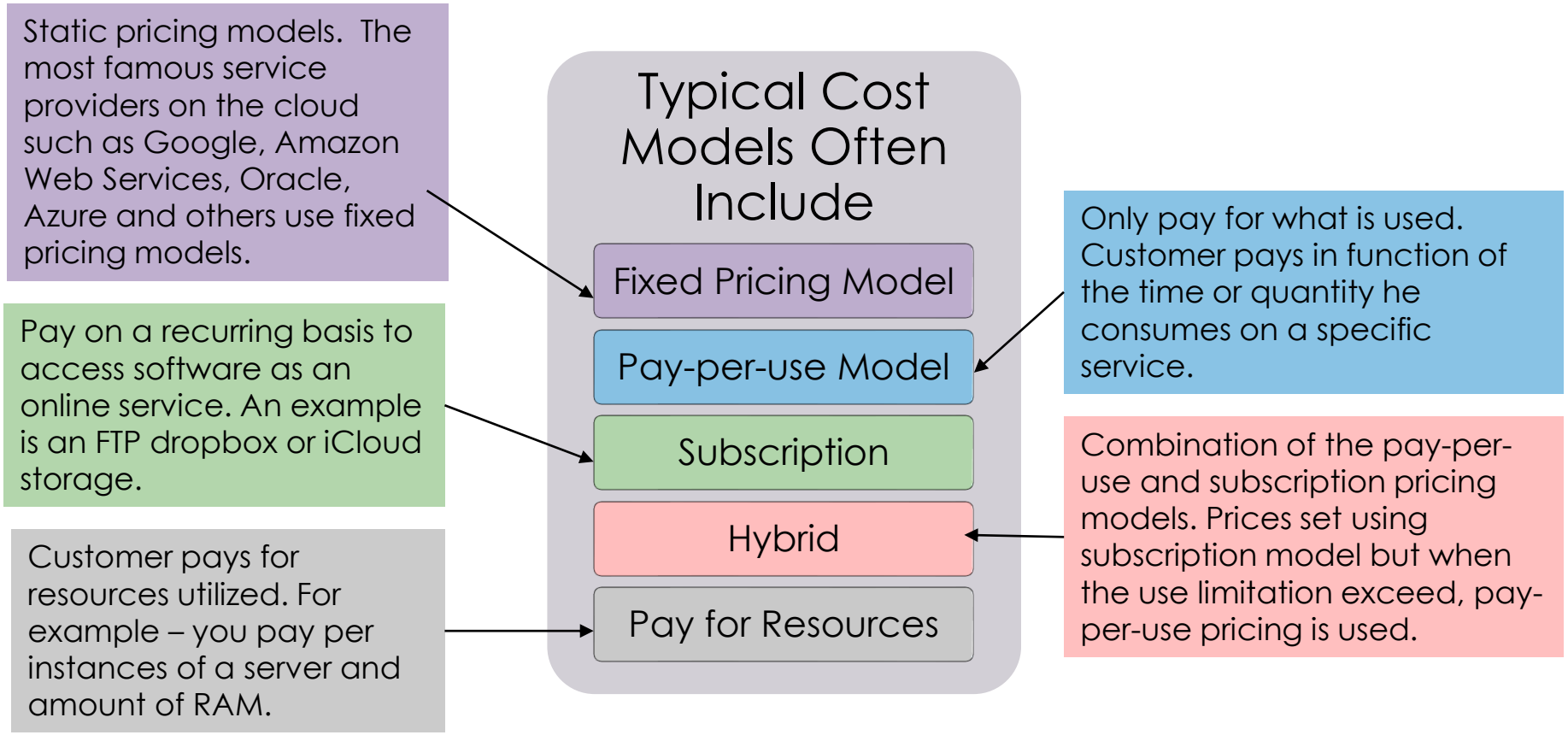
Costs Often Include

- Fixed Pricing Model
- Pay-per-use Model
- Subscription
- Hybrid
- Pay for Resources

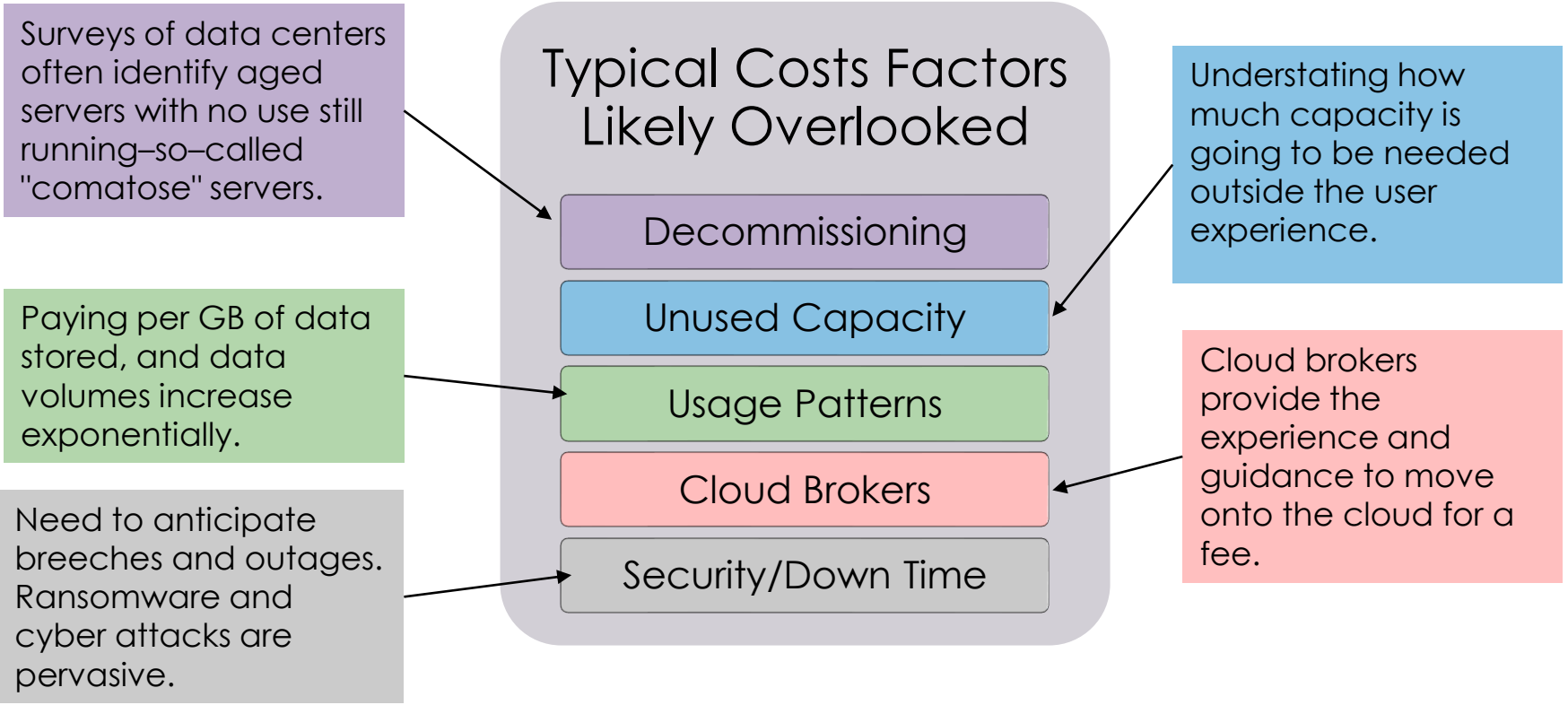
Cost Often Overlooked

- Decommissioning
- Unused Capacity
- Usage Patterns
- Cloud Brokers
- Security/Down Time

Cloud Computing Cost Models



Cloud Computing Cost Models



Conclusion

Three Takeaways From Today

1. The Cloud is Pervasive

2. Not everything is in the Cloud

3. Expect the Cloud to cost more than expected

Questions?

Presenters

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Bob Hunt has over 40 years of cost estimating and analysis experience. He received his Society for Cost Estimating and Analysis (SCA) Certification in 1991. He has served in senior technical and management positions at Dulos Incorporated (President), Galorath Federal Incorporated (President), Galorath Incorporated (Vice President for Services), CALIBRE Systems (Vice President), CALIBRE Services (President), SAIC (Vice President), the U.S. Army Cost and Economic Analysis Center (Chief of the Vehicles, Ammunition, and Electronics ICE Division, U.S. Army Directorate of Cost Analysis (Deputy Director).

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